Science Standards of Learning

Teacher Resource Guide

Appendix

Commonwealth of Virginia
Department of Education
Richmond, Virginia
2000

APPENDIX Science Skill Scope and Sequence

OBSERVING:
To perceive using one or more of the senses.

Grade/Subject	Skill statements from the "Investigation, Reasoning, and Logic" Strand
Kindergarten	· basic properties of objects are identified by direct observation · observations are made from multiple positions to achieve different perspectives
1st Grade	· differences in physical properties are observed using the senses and simple instruments to enhance observations (magnifying glass)
2nd Grade	· observations are repeated to improve accuracy · observation is differentiated from personal interpretation, and conclusions are drawn based on observations
3rd Grade	· predictions and observations are made (repeated - Predicting)
4th Grade	· distinctions are made among observations, conclusions (inferences), and predictions (repeated - Predicting)
5th Grade	
6th Grade	· observations are made involving fine discrimination between similar objects and organisms
Life Science	
Physical Science	
Earth Science	
Biology	· observations of living things are recorded in the lab and in the field
Chemistry	
Physics	· instruments are selected and used to extend observations and measurements of mass, volume, temperature, heat exchange, energy transformations, motion, fields, and electric charge (repeated - Measuring)

CLASSIFYING AND SEQUENCING:
To arrange or distribute objects, events, or ideas according to some method or system

Grade/Subject	Skill statements from the "Investigation, Reasoning, and Logic" Strand
Kindergarten	· a set of objects is sequenced according to size · a set of objects is separated into two groups based on a single physical attribute
1st Grade	· objects or events are classified and arranged according to attributes or properties
2nd Grade	· two or more attributes are used to classify items
3rd Grade	· objects with similar characteristics are classified into at least two sets and two subsets · natural events are sequenced chronologically
4th Grade	
5th Grade	· rocks, minerals, and organisms are identified using a classification key
6th Grade	· a classification system is developed based on multiple attributes
Life Science	
Physical Science	
Earth Science	
Biology	
Chemistry	
Physics	

COMMUNICATING:
To gather, record, and transmit qualitative or quantitative information including defining operationally; using expert, print, and electronic resources; gathering, charting, recording, and graphing data; and presenting information in standard written narrative, oral, audio-visual, and electronic formats.

Grade/Subject	Skill statements from the "Investigation, Reasoning, and Logic" Strand
Kindergarten	· picture graphs are constructed using 10 or fewer units · objects are described both pictorially and verbally
1st Grade	· observations and data are communicated orally and with simple graphs, pictures, written statements, and numbers
2nd Grade	· picture and bar graphs are constructed using numbered axes
3rd Grade	· data are gathered, charted, and graphed
4th Grade	
5th Grade	· data are collected, recorded, and reported using the appropriate graphical representation (graphs, charts, diagrams)
6th Grade	· differences in descriptions and working definitions are made · data are organized and communicated through graphical representation (graphs, charts, and diagrams)
Life Science	· data are organized into tables showing repeated trials and means
Physical Science	· triple beam and electronic balances, thermometers, metric rulers, graduated cylinders, and spring scales are used to gather data (repeated - Measuring) · data from experiments are recorded and interpreted from bar, line, and circle graphs (repeated - Analyzing Data) · research skills are utilized using a variety of resources · experimental results are presented in appropriate written form
Earth Science	· scales, diagrams, maps, charts, graphs, tables, and profiles are constructed and interpreted (repeated - Modeling)

Grade/Subject	Skill statements from the "Investigation, Reasoning, and Logic" Strand
Biology	· appropriate technology is used for gathering and analyzing data and communicating results (repeated - Analyzing Data) · research is used based on popular and scientific literature
Chemistry	
Physics	· the components of a system are defined · information is recorded and presented in an organized format · a description of a physical problem is translated into a mathematical statement in order to find a solution (repeated -Analyzing Data)

MEASURING:
To develop a comparative or quantitative description of properties such as mass, length, volume, and temperature.

Grade/Subject	Skill statements from the "Investigation, Reasoning, and Logic" Strand
Kindergarten	· nonstandard units are used to measure common objects
1st Grade	· length, mass, and volume are measured using standard and nonstandard units
2nd Grade	· linear, volume, mass, and temperature measurements are made in metric (centimeters, meters, liters, degrees Celsius, grams, kilograms) and standard English units (inches, feet, yards, pints, quarts, gallons, degrees Fahrenheit, ounces, pounds)
3rd Grade	· length is measured to the nearest centimeter · mass is measured to the nearest gram · volume is measured to the nearest milliliter and liter · temperature is measured to the nearest degree Celsius · time is measured to the nearest minute
4th Grade	· appropriate metric measures are used to collect, record, and report data · appropriate instruments are selected to measure linear distance, volume, mass, and temperature
5th Grade	· appropriate instruments are selected and used for making quantitative observations of length, mass, volume, and elapsed time · accurate measurements are made using basic tools (thermometer, meter stick, balance, graduated cylinder)
6th Grade	· precise and approximate measures are recorded · data are collected, recorded, analyzed, and reported using appropriate metric measurement
Life Science	· SI (metric) units are used
Physical Science	· length, mass, volume, density, temperature, weight, and force are accurately measured and reported using the

Grade/Subject	Skill statements from the "Investigation, Reasoning, and Logic" Strand
	International System of Units (SI - metric) · triple beam and electronic balances, thermometers, metric rulers, graduated cylinders, and spring scales are used to gather data (repeated- Communicating)
Biology	
Chemistry	· SI units (are used)
Physics	· instruments are selected and used to extend observations and measurements of mass, volume, temperature, heat exchange, energy transformations, motion, fields, and electric charge (repeated - Observing) · metric units are used in all measurements and calculations · data gathered from non-SI instruments are incorporated through appropriate conversions

PREDICTING:
To forecast a possible result on the basis of information acquired from systematic observations, scientific principles, and laws.

Grade/Subject	Skill statements from the "Investigation, Reasoning, and Logic" Strand
Kindergarten	· an unseen member in a sequence of objects is predicted
1st Grade	· predictions are based on patterns of observation rather than random guesses
2nd Grade	
3rd Grade	· predictions and observations are made
4th Grade	· distinctions are made among observations, conclusions (inferences), and predictions (repeated - Observing) · predictions are made based on data from picture graphs, bar graphs, and basic line graphs (repeated - Analyzing Data)
5th Grade	· predictions are made using patterns, and simple graphical data are extrapolated (repeated - Analyzing Data) · estimations of length, mass, and volume are made
6th Grade	· a method is devised to test the validity of predictions and inferences · scale models are used to estimate distance, volume, and quantity (repeated - Modeling)
Life Science	· criteria are established for evaluating a prediction · continuous line graphs are constructed, interpreted, and used to make predictions (repeated - Analyzing Data)
Physical Science	
Earth Science	
Biology	
Chemistry	
Physics	· interpolated, extrapolated, and analyzed trends are used to make predictions (repeated - Analyzing Data)

HYPOTHESIZING:
To make a testable prediction about the relationship between variables in a system.

Grade/Subject	Skill statements from the "Investigation, Reasoning, and Logic" Strand
Kindergarten	· a question is developed from one or more observations
1st Grade	
2nd Grade	· conditions that influence a change are defined
3rd Grade	· questions are developed to formulate hypotheses
4th Grade	· hypotheses are formulated based on cause and effect relationships
5th Grade	
6th Grade	· hypotheses are stated in ways that identify the independent (manipulated) and dependent (responding) variables
Life Science	· variables are controlled to test hypotheses and trials are repeated (repeated - Using Variables)
Physical Science	
Earth Science	
Biology	· hypotheses are formulated based on observations
Chemistry	
Physics	

INFERRING:
To derive a reasoned conclusion based on verifiable evidence and systematic observations.

Grade/Subject	Skill statements from the "Investigation, Reasoning, and Logic" Strand
Kindergarten	
1st Grade	· inferences are made and conclusions are drawn about familiar objects and events
2nd Grade	· observation is differentiated from personal interpretation, and conclusions are drawn based on observations (repeated - Observing)
3rd Grade	· inferences are made and conclusions are drawn
4th Grade	· distinctions are made among observations, conclusions (inferences), and predictions (repeated - Predicting)
5th Grade	
6th Grade	· a method is devised to test the validity of predictions and inferences (repeated - Using Variables)
Life Science	
Physical Science	· valid conclusions are made after analyzing data (repeated - Analyzing Data)
Earth Science	
Biology	· conclusions are formed based on recorded quantitative and qualitative data
Chemistry	
Physics	

USING VARIABLES IN EXPERIMENTATION:

To change one variable intentionally under controlled conditions.

Grade/Subject	Skill statements from the "Investigation, Reasoning, and Logic" Strand
Kindergarten	
1st Grade	· simple experiments are conducted to answer questions
2nd Grade	
3rd Grade	
4th Grade	· variables that must be held constant in an experimental situation are defined
5th Grade	
6th Grade	· one variable is manipulated over time with many repeated trials
Life Science	· variables are defined · sources of experimental error are identified · dependent variables, independent variables, and constants are identified · variables are controlled to test hypotheses and trials are repeated
Physical Science	· independent and dependent variables, constants, controls, and repeated trials are identified · research methods are used to investigate practical problems and questions
Earth Science	· variables are manipulated with repeated trials
Biology	· variables are defined and investigations are designed to test hypotheses
Chemistry	· designated laboratory techniques (are used) · multiple variables are manipulated with repeated trials
Physics	· the limitations of the experimental apparatus and design are recognized · the limitations of measured quantities through the appropriate use of significant figures or error ranges are recognized

DESIGNING, CONSTRUCTING, AND INTERPRETING MODELS:
To build a mental or physical representation of an idea for explanation and interpretation.

Grade/Subject	Skill statements from the "Investigation, Reasoning, and Logic" Strand
Kindergarten	
1st Grade	
2nd Grade	· simple physical models are constructed
3rd Grade	
4th Grade	
5th Grade	
6th Grade	· scale models are used to estimate distance, volume, and quantity (repeated - Predicting) · models are designed to explain a sequence
Life Science	· models are constructed to illustrate and explain phenomena
Physical Science	
Earth Science	· technologies, including computers, are used to collect, analyze, and report data and to demonstrate concepts and simulate experimental conditions (repeated - Analyzing Data) · scales, diagrams, maps, charts, graphs, tables, and profiles are constructed and interpreted (repeated - Communicating)
Biology	
Chemistry	
Physics	· a description of a physical problem is translated into a mathematical statement in order to find a solution (repeated - Analyzing Data)

INTERPRETING, ANALYZING, AND EVALUATING DATA:
To explain information, determine its essential features and meaning, and critically judge which data are meaningful or useful to the question under study.

Grade/Subject	Skill statements from the "Investigation, Reasoning, and Logic" Strand
Kindergarten	· unusual or unexpected results in an activity are recognized
1st Grade	
2nd Grade	· unexpected or unusual quantitative data are recognized
3rd Grade	
4th Grade	· data are classified to create frequency distributions · predictions are made based on data from picture graphs, bar graphs, and basic line graphs (repeated - Predicting) · numerical data that are contradictory or unusual in experimental results are recognized
5th Grade	· predictions are made using patterns, and simple graphical data are extrapolated (repeated - Predicting)
6th Grade	· a method is devised to test the validity of predictions and inferences
Life Science	· continuous line graphs are constructed, interpreted, and used to make predictions (repeated - Predicting) · interpretations from the same set of data are evaluated and defended
Physical Science	· data from experiments are recorded and interpreted from bar, line, and circle graphs (repeated - Communicating) · valid conclusions are made after analyzing data
Earth Science	· technologies, including computers, are used to collect, analyze, and report data and to demonstrate concepts and simulate experimental conditions (repeated - Modeling) · a scientific viewpoint is constructed and defended

Grade/Subject	Skill statements from the "Investigation, Reasoning, and Logic" Strand
Biology	· graphing and arithmetic calculations are used as tools in data analysis · conclusions are formed based on recorded quantitative and qualitative data (repeated - Inferring) · impacts of sources of error inherent in experimental design are identified and discussed · validity of data is determined · alternative explanations and models are recognized and analyzed · appropriate technology is used for gathering and analyzing data and communicating results (repeated - Communicating)
Chemistry	· accurate recording, organizing, and analysis of data through repeated trials · mathematical and procedural error analysis · mathematical manipulations (SI units, scientific notation, linear equations, graphing, ratio and proportion, significant digits, dimensional analysis, use of scientific calculator)
Physics	· a description of a physical problem is translated into a mathematical statement in order to find a solution (repeated - Modeling) · relationships between physical quantities are determined using the shape of a curve passing through experimentally obtained data · the slope of a linear relationship is calculated and includes appropriate units · interpolated, extrapolated, and analyzed trends are used to make predictions · inferential statistical tests are applied in evaluating experimental data · analysis of systems employs vector quantities utilizing trigonometric and graphical methods